



# education

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Department:  
Education  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE/GRAAD 12**

**PHYSICAL SCIENCE: CHEMISTRY (P2)  
FISIESE WETENSKAPPE: CHEMIE (P2)**

**MEMORANDUM**

**EXEMPLAR/MODEL 2008**

**MARKS/PUNTE: 150**

**This memorandum consists of 14 pages.  
*Hierdie memorandum bestaan uit 14 bladsye.***

**NATIONAL DEPARTMENT OF EDUCATION  
MEMORANDUM  
PHYSICAL SCIENCES GRADE 12 PAPER 2 EXEMPLAR 2008  
FISIËSE WETENSKAPPE GRAAD 12 VRAESTEL 2 MODEL 2008**

<b>Learning Outcomes and Assessment Standards Leeruitkomst en Assesseringstandaarde</b>		
<b>LO 1 / LU 1</b>	<b>LO 2 / LU 2</b>	<b>LO 3 / LU 3</b>
<p><b>AS 12.1.1:</b> Design, plan and conduct a scientific inquiry to collect data systematically with regard to accuracy, reliability and the need to control variables.</p> <p><i>Ontwerp, beplan en voer 'n wetenskaplike ondersoek uit om data te versamel ten opsigte van akkuraatheid, betroubaarheid en die kontroleer van veranderlikes.</i></p> <p><b>AS 12.1.2:</b> Seek patterns and trends, represent them in different forms, explain the trends, use scientific reasoning to draw and evaluate conclusions, and formulate generalisations.</p> <p><i>Soek patrone en tendense, stel dit in verskillende vorms voor, verduidelik tendense, gebruik wetenskaplike beredenering om gevolgtrekkings te maak en te evalueer, en formuleer veralgemenings.</i></p> <p><b>AS 12.1.3:</b> Select and use appropriate problem-solving strategies to solve (unseen) problems.</p> <p><i>Kies en gebruik geskikte probleemoplossingsstrategieë toe om (ongesiene) probleme op te los.</i></p> <p><b>AS 12.1.4:</b> Communicate and defend scientific arguments with clarity and precision.</p> <p><i>Kommunikeer en verdedig wetenskaplike argumente duidelik en presies.</i></p>	<p><b>AS 12.2.1:</b> Define, discuss and explain prescribed scientific knowledge.</p> <p><i>Definieer, bespreek en verduidelik voorgeskrewe wetenskaplike kennis.</i></p> <p><b>AS 12.2.2</b> Express and explain prescribed scientific principles, theories, models and laws by indicating the relationship between different facts and concepts in own words.</p> <p><i>Verduidelik en druk voorgeskrewe wetenskaplike beginsels, teorieë, modelle en wette uit deur die verwantskap tussen verskillende feite konsepte in eie woorde aan te dui.</i></p> <p><b>AS 12.2.3:</b> Apply scientific knowledge in everyday life contexts.</p> <p><i>Pas wetenskaplike kennis in kontekste van die alledaagse lewe toe.</i></p>	<p><b>AS 12.3.2:</b> Research case studies and present ethical and moral arguments from different perspectives to indicate the impact (pros and cons) of different scientific and technological applications.</p> <p><i>Vors gevallestudies na en lewer etiese en morele argumente uit verskillende perspektiewe om die impak (voordele en nadele) van verskillende wetenskaplike en tegnologiese toepassings aan te dui.</i></p> <p><b>AS 12.3.3:</b> Evaluate the impact of scientific and technological research and indicate the contribution to the management, utilisation and development of resources to ensure sustainability continentally and globally.</p> <p><i>Evalueer die impak van wetenskaplike en tegnologiese navorsing en dui die bydrae tot bestuur, benutting en ontwikkeling van bronne om volhoubaarheid kontinentaal en globaal te verseker.</i></p>

**SECTION A / AFDELING A****QUESTION 1 / VRAAG 1**

1.1	isomers (structural isomers)/ <i>isomere (struktuurisomere)</i> ✓	[12.2.1]	(1)
1.2	activated complex/ <i>geaktiveerde kompleks</i> ✓	[12.2.1]	(1)
1.3	electrolyte/ <i>elektroliet</i> ✓	[12.2.1]	(1)
1.4	reducing agent/ <i>reduseermiddel</i> ✓	[12.2.1]	(1)
1.5	fractional distillation/ <i>fraksionele distillasie</i> ✓	[12.2.1]	(1)
			<b>[5]</b>

**QUESTION 2 / VRAAG 2**

2.1	D ✓	[12.2.3]	(1)
2.2	C ✓	[12.2.1]	(1)
2.3	G ✓	[12.2.1]	(1)
2.4	I ✓	[12.2.1]	(1)
2.5	J ✓	[12.2.1]	(1)
			<b>[5]</b>

**QUESTION 3 / VRAAG 3**

- 3.1 True / *Waar* ✓✓ [12.2.1] (2)
- 3.2 False / *Onwaar* ✓  
Concentrations of products and reactants are constant. ✓  
*Konsentrasies van produkte en reaktante is konstant.*  
OR/OF  
Rate of forward reaction = rate of reverse reaction  
*Tempo van die voorwaarde reaksie = tempo van terugwaarde reaksie* [12.2.3] (2)
- 3.3 False / *Onwaar* ✓  
... in a closed container equilibrium can be reached after a while. ✓  
*... in 'n geslote houer kan ewewig na 'n tyd bereik word.*  
  
OR/OF  
Equilibrium cannot be reached in an open system.  
*Ewewig kan nie in 'n oop sisteem bereik word nie.* [12.2.3] (2)
- 3.4 True / *Waar* ✓✓ [12.2.3] (2)
- 3.5 False / *Onwaar* ✓  
Electrical energy is converted to chemical energy. ✓  
*Elektriese energie word omgeskakel in chemiese energie.* [12.2.3] (2)

**[10]****QUESTION 4 / VRAAG 4**

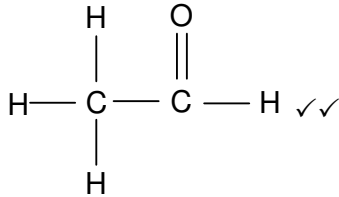
- 4.1 B ✓✓✓ [12.2.3] (3)
- 4.2 D ✓✓✓ [12.2.3] (3)
- 4.3 C ✓✓✓ [12.2.2] (3)
- 4.4 D ✓✓✓ [12.2.3] (3)
- 4.5 C ✓✓✓ [12.2.3] (3)

**[15]****TOTAL SECTION A: 35  
TOTAAL AFDELING A: 35**

**SECTION B / AFDELING B****QUESTION 5 / VRAAG 5**

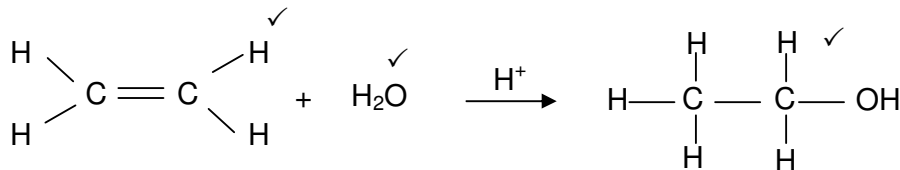
5.1 ethanal / *etanaal* – aldehydes / *aldehyede* ✓  
ethanoic acid / *etanoësuur* – carboxylic acids / *karboksielsure* ✓ [12.2.1] (2)

5.2



[12.2.3] (2)

5.3



[12.2.3] (3)

5.4 Any additional intake of alcohol will increase the blood alcohol level ✓✓ which may then lead to either loss of coordination / severe poisoning / damage to organs e.g. the liver. ✓✓

*Enige ekstra inname van alkohol sal die alkoholvlakke in die bloed laat toeneem wat of tot verlies aan koördinasie / ernstige vergiftiging / orgaanskade bv. lewerskade kan lei.*

[12.3.2] (4)  
**[11]**

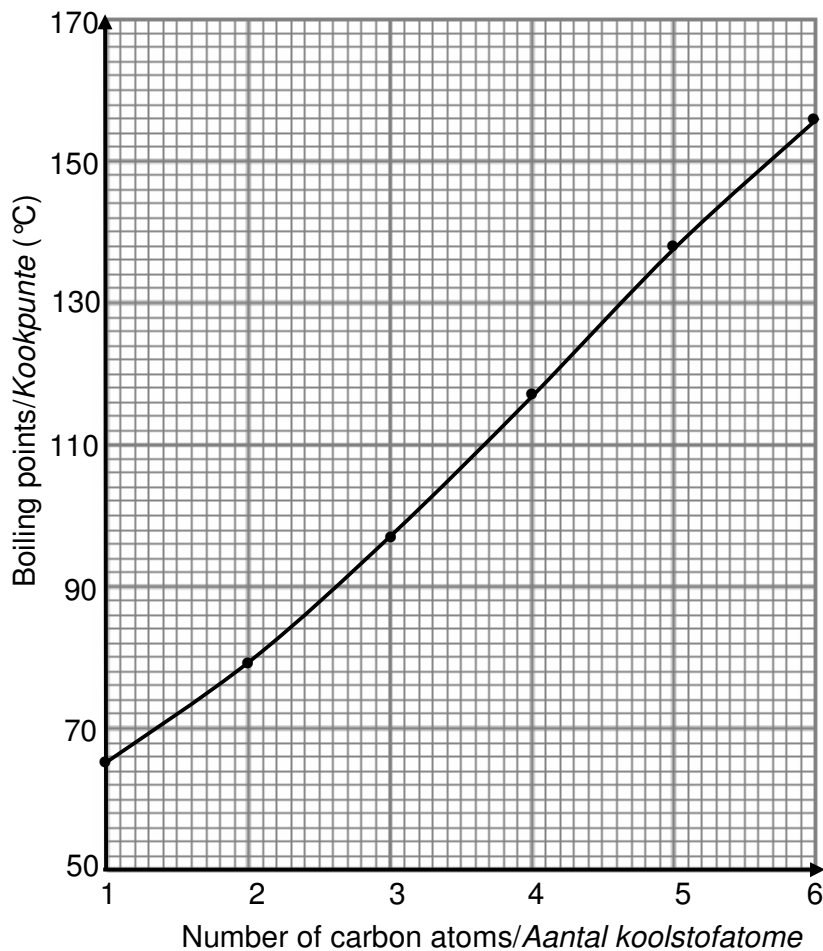
**QUESTION 6 / VRAAG 6**

- 6.1 High energy of combustion/Combustion releases huge amounts of energy/highly exothermic. ✓✓  
*Hoë verbrandingswarmte/Verbranding stel groot hoeveelhede energie vry/hoogs eksotermies.*

[12.3.2] (2)

6.2

Graph of boiling points versus number of carbon atoms  
*Grafiek van kookpunte teenoor aantal koolstofatome*



<b>Criteria for graph/Kriteria vir grafiek:</b>	
Appropriate heading/Geskikte <i>opskrif</i>	✓
Appropriate scale on both axes/Geskikte <i>skaal op beide asse</i>	✓
Both axes labelled correctly/Beide <i>asse korrek benoem</i>	✓
Points correctly plotted/Punte <i>korrek gestip</i>	✓
Best curve drawn through points/Beste <i>kurwe deur punte getrek</i>	✓
Total/Totaal	5

[12.1.2] (5)

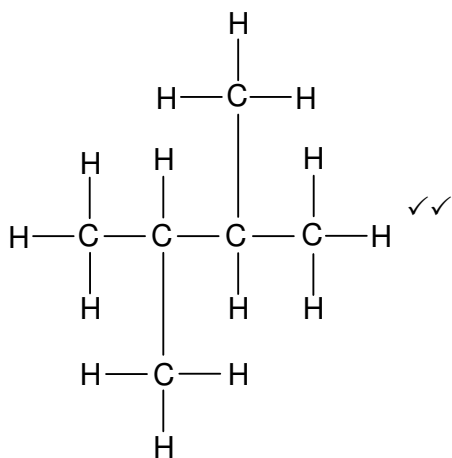
- 6.3 Boiling point increases with number of carbon atoms ✓✓  
*Kookpunt neem toe met aantal koolstofatome* [12.1.2] (2)
- 6.4 *Van der Waals forces between alcohol molecules ✓  
increase with increase in molecular size ✓*  
Van der Waalskragte tussen alkoholmolekule neem toe met toename  
in molekuulgrootte [12.2.2.] (2)
- 6.5 Hydrogen bonds between alcohol molecules are stronger ✓  
than Van der Waals forces between molecules of alkanes ✓  
*Waterstofbindinge tussen alkoholmolekule is sterker as Van der  
Waalskragte tussen alkaanmolekule* [12.2.2.] (2)
- 6.6 Petrol has a low boiling point ✓, vapourises easily / is volatile /  
explosive / flammable / easily combustible / vapours have a higher  
density than oxygen ✓  
and when swallowed vapours can cause suffocation.  
  
*Petrol het lae kookpunt, verdamp maklik / is vlugtig / is plofbaar /  
vlambaar / dampe het 'n hoër digtheid as suurstof  
en wanneer ingeneem kan dit tot versmoring lei.* [12.3.2] (2)
- 6.7 Ethanol can be produced by fermentation of plant material e.g. maize  
and sugar cane. ✓  
Alkanes are fossil fuels ✓ which are non-renewable.  
  
*Etanol kan deur fermentasie van plantaardige gewasse bv. mielies en  
suikerriet vervaardig word. Alkane word uit fossielbrandstowwe  
vervaardig.* [12.3.3] (2)  
**[17]**

**QUESTION 7 / VRAAG 7**

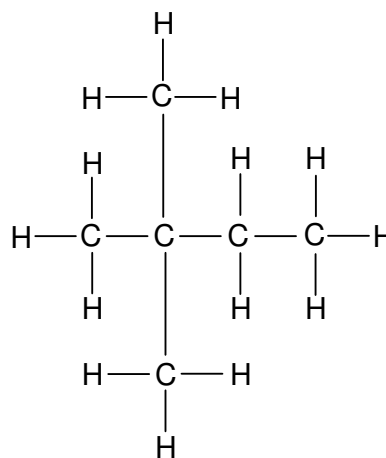
7.1  $\text{CH}_4 + \text{Cl}_2 \checkmark \rightarrow \text{CH}_3\text{Cl} + \text{HCl} \checkmark$  (bal  $\checkmark$ ) [12.2.3] (3)

7.2 4,4-dimethyl-2-hexanone/4,4-dimetiel-2-heksanoon  $\checkmark \checkmark$  [12.2.3] (2)

7.3

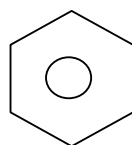
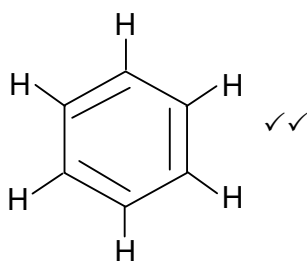


OR

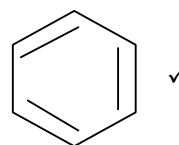


[12.2.3] (2)

7.4



OR



[12.2.3] (2)  
**[9]**

**QUESTION 8 / VRAAG 8**

- 8.1 Any statement that refers to the relationship between the dependent and independent variables. / *Enige stelling wat na die afhanklike en onafhanklike veranderlikes verwys.*

<b>Checklist/Kontrolelys</b>	Marks/ Punte
Criteria for hypothesis/ <i>Kriteria vir hipotese</i>	
Statement that can be proved true or false (not an aim) <i>Stelling wat reg of verkeerd bewys kan word (nie 'n doel nie)</i>	✓
Statement refers to relationship between dependent and independent variables <i>Stelling verwys na verwantskap tussen afhanklike en onafhanklike veranderlikes</i>	✓

Examples/Voorbeelde:

A larger mass of metal will produce more gas. / *Groter massa van die metaal sal meer gas produseer.* ✓✓

OR/OF

A larger mass of metal will produce less gas. / *'n Groter massa metaal sal minder gas produseer.*

[12.1.2] (2)

- 8.2 Temperature / *Temperatuur* ✓✓  
Same concentration of acid / *Dieselfde konsentrasie suur* ✓✓  
(Not state of division/ *toestand van verdeeldheid*)

[12.1.2] (4)

- 8.3 Any mass bigger than 1,6 g will not influence the volume of gas produced ✓✓  
*Enige massa meer as 1,6 g sal nie die volume gas wat produseer word beïnvloed nie.*

[12.1.2] (2)

- 8.4 160 - 170 cm<sup>3</sup> ✓✓

[12.1.2] (2)

**[10]**

**QUESTION 9 / VRAAG 9**

At higher temperatures, the number of molecules with the minimum  $E_k$  needed for a reaction increases ✓✓

The number of molecules that can overcome the activation energy increases. ✓

The molecules move faster, frequency of collisions increases ✓ hence the rate of reaction increases. ✓

*By hoër temperature neem die aantal molekule met 'n minimum  $E_k$  toe. Die aantal molekule wat die aktiveringsenergie kan oorkom neem toe. Die molekule beweeg vinniger en die frekwensie van botsings neem toe. Dus neem die reaksietempo toe.*

[12.1.2]

**[5]**

**QUESTION 10 / VRAAG 10**

10.1 It is easier ✓ to form products from reactants because the activation energy is much less ✓ than the energy required to form reactants from products.

*Dit is makliker om produkte uit reaktante te vorm omdat die aktiveringsenergie minder is as die vir die vorming van reaktante uit produkte.*

[12.3.2] (2)

10.2 CO is poisonous ✓✓  
*CO is giftig*

[12.3.2] (2)

10.3 It ensures that converting products to CO<sub>2</sub> minimises the danger of CO poisoning. ✓✓

*Dit verseker dat die omskakel van produkte na CO<sub>2</sub> die gevaar van CO vergiftiging verminder.*

[12.3.2] (2)  
**[6]**

**QUESTION 11 / VRAAG 11**

- 11.1 The reaction is exothermic.  
Lowering the temperature favours a higher yield of ammonia, ✓ but the rate of the reaction is drastically reduced ✓  
Production is unprofitable. ✓

*Die reaksie is eksotermies.*

*Verlaging van die temperatuur bevoordeel 'n groter opbrengs van ammoniak, maar die tempo van die reaksie neem drasties af. Produksie is nie winsgewend nie.*

[12.2.3] (3)

11.2.1

	NH <sub>3</sub>	O <sub>2</sub>	NO	H <sub>2</sub> O	
Initial/ Aanvanklik [ ]	1	1	0	0	✓
Change in/ Verandering in [ ]	0,25	0,3125 ✓	0,25	0,375 ✓	
Equilibrium/ Ewewig [ ]	<b>0,75</b>	<b>0,6875</b> ✓	0,25	0,375	✓

$$K_C = \frac{[\text{NO}]^4 [\text{H}_2\text{O}]^6}{[\text{NH}_3]^4 [\text{O}_2]^5} \quad \checkmark$$

$$= \frac{(0,25)^4 (0,375)^6}{(0,75)^4 (0,6875)^5} \quad \checkmark \checkmark$$

$$\therefore K_C = 2,2 \times 10^{-4} \quad \checkmark$$

[12.1.3] (9)

- 11.2.3 Low/Laag ✓  
K<sub>C</sub> value is very small and indicates that there are more reactants than product molecules in the reaction mixture at equilibrium. ✓✓  
*Kc waarde is baie klein en dui aan dat daar meer reaktante as produk molekule in die reaksiemengsel is.*

[12.1.2] (3)  
**[15]**

**QUESTION 12 / VRAAG 12**

- 12.1 The build-up of  $H_2(g)$  in the cell ✓ could cause the cell to burst or explode if ignited. ✓  
*Die opbou van  $H_2(g)$  in die sel kan veroorsaak dat die sel bars of ontplof wanneer aan die brand gesteek.* [12.3.2] (2)
- 12.2  $Zn \rightarrow Zn^{2+} + 2e^-$  ✓✓  
Alternative answers/Alternatiewe antwoorde:  
 $Zn \rightleftharpoons Zn^{2+} + 2e^-$  ( $\frac{1}{2}$ )  
 $Zn \leftarrow Zn^{2+} + 2e^-$  ( $\frac{0}{2}$ )  
 $Zn^{2+} + 2e^- \leftarrow Zn$  ( $\frac{2}{2}$ )  
 $Zn^{2+} + 2e^- \rightleftharpoons Zn$  ( $\frac{0}{2}$ ) [12.2.3] (2)
- 12.3  $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$   
 $2NH_4^+(aq) + 2MnO_2(s) + 2e^- \rightarrow Mn_2O_3(s) + 2NH_3(g) + H_2O(l)$   
 $Zn(s) + 2NH_4^+(aq) + 2MnO_2(s) \rightarrow Zn^{2+}(aq) + Mn_2O_3(s) + 2NH_3(g) + H_2O(l)$  ✓✓ [12.2.3] (2)
- 12.4.  $E_{cell}^{\theta} = E_{cathode}^{\theta} - E_{anode}^{\theta}$  ✓  
 $1,5 = E_{cathode}^{\theta} - (-0,76)$  ✓✓  
 $E_{cathode}^{\theta} = +0,74V$  ✓ [12.2.3] (4)
- 12.5  $NH_4^+$  is an acid and reacts with the zinc casing. ✓✓  
 *$NH_4^+$  is 'n suur en reageer met die sinkomhulsel.* [12.2.3] (2)
- 12.6 Can be reused as an electrode in other situations. ✓✓  
*Kan hergebruik word as elektrode in ander situasies.* [12.3.2] (2)

**[14]**

**QUESTION 13 / VRAAG 13**

- 13.1 Any two:/*Enige twee:*  
 Less pollution/*minder besoedeling* ✓  
 Cheaper/*goedkoper* ✓  
 Product more pure/*produk is suiwerder* [12.3.2] (2)
- 13.2 Do not react and can be used more than once ✓✓  
*Reageer nie en kan oor en oor gebruik word* [12.2.3] (2)
- 13.3  $2 \text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$  ✓ ✓ [12.2.3] (2)
- 13.4 Gas A ✓ ✓ [12.2.3] (2)
- 13.5  $\text{Na}^+$  ions migrate through membrane to cathode ✓  
 $\text{H}^+$  ions (from  $\text{H}_2\text{O}$  in solution) are reduced to  $\text{H}_2$  that escapes ✓  
 $\text{Na}^+$  ions combine with remaining  $\text{OH}^-$  ions (from  $\text{H}_2\text{O}$  in solution) ✓  
 to form NaOH
- Na<sup>+</sup>-ione beweeg deur die membraan na die katode  
 H<sup>+</sup>-ione (vanaf H<sub>2</sub>O in oplossing) word reduseer na H<sub>2</sub> wat ontsnap  
 Na<sup>+</sup>-ione verbind met die oorblywende OH<sup>-</sup>-ione (vanaf die H<sub>2</sub>O in die  
 oplossing) om NaOH te vorm.* [12.1.4] (3)

**[11]**

**QUESTION 14 / VRAAG 14**

- 14.1  $2\text{NO} + \text{O}_2 \checkmark \rightarrow 2\text{NO}_2 \checkmark$  (bal  $\checkmark$ ) [12.1.2] (3)
- 14.2 Catalytic oxidation of ammonia/*katalitiese oksidasie van ammoniak*  $\checkmark\checkmark$  [12.1.2] (2)
- 14.3  $\text{HNO}_3 \checkmark\checkmark$  [12.1.2] (2)
- 14.4 D –  $(\text{NH}_4)_2\text{SO}_4 \checkmark\checkmark$   
E –  $\text{NH}_4\text{NO}_3 \checkmark\checkmark$  [12.3.2] (4)
- 14.5 Any three / *Enige drie*:  
Nitrogen saturation of soil leads to washing away of other nutrients needed in the soil. / *Stikofversadiging van grond lei tot die wegwas van voedingstowwe nodig in die grond.*  $\checkmark\checkmark$
- Washing of top soil into lakes/rivers/dams causes it to become acidic. / *Die was van bogrond in mere/riviere/damme veroorsaak dat die water suur word.*  $\checkmark\checkmark$
- Build up of nitrates in rivers (eutrophication) causes algae bloom that depletes oxygen causing aquatic life to die. / *Opbou van nitrate in riviere (eutrofikasie) veroorsaak groei van alge wat die suurstof uitput en waterlewe laat doodgaan.*  $\checkmark\checkmark$
- Built up of nitrates in drinking water can cause death under infants due to lack of haemoglobin deficiency. / *Opbou van nitrate in drinkwater kan die dood van babas veroorsaak weens tekort aan hemoglobien.*
- Groundwater can become acidic./Grondwater kan suur word.
- Promotes growth of alien plants. / *Bevorder groei van indringer plante.* [12.3.3] (6)

**[17]****TOTAL SECTION/TOTAAL AFDELING B: 115****GRAND TOTAL/GROOT TOTAAL: 150**